Veterinary Invertebrate Society Newsletter

tadpole shrimp *Triops cancriformis*
photo: Ian Hughes

Membership

Membership of the Veterinary Invertebrate Society is available to anyone with an interest in veterinary aspects of the care, husbandry and biology of captive and free-living invertebrates. Full membership is open to veterinarians and veterinary students; associate membership is open to others. Annual membership fees are £10 for all full and associate members, except veterinary undergraduates, for whom the fee is £2. Fees should be paid by cheque or money order in sterling to Veterinary Invertebrate Society.

All enquiries concerning membership should be addressed to: Graham Rendall,
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Salisbury,
Wiltshire SP1 3BT
United Kingdom

Instructions to contributors

The purpose of the Veterinary Invertebrate Society Newsletter is to disseminate advances in veterinary aspects of the care, husbandry and biology of captive and free-living invertebrates. The newsletter also provides a medium of communication between the Society's members.

The editorial board invites the submission of original material for publication. Items may be anything from short notes of one or two paragraphs to articles of several pages length. Manuscripts in English are welcomed in any form; however if possible, please supply material on floppy disc in a MS Windows compatible format, preferably in MS Word, in addition to any hard copies sent. This makes it much easier for us to process your contribution for publication! We can also receive material sent by E-mail to the address shown below.

Generally we will accept all items with useful veterinary, husbandry or news content. Examples include letters, husbandry notes, reports of clinical cases and research, accounts of meetings, reviews of new publications and any other items of interest to members of the Society. Contributions will not normally be peer-reviewed. Authors are therefore themselves responsible for avoiding copyright infringement and for the validity of all factual statements, methods and conclusions and for any spelling or grammatical errors we miss.

In scientific articles references should be listed in alphabetical order in this form:

> Robinson, M. H. (1991) Invertebrates: exhibiting the silent majority. *International Zoo Yearbook* **30** 1-7.

Please provide the genus and species of each organism, in italics, the first time it is given in the text, after the common name (e.g. mole cricket *Gryllotalpa gryllotalpa*). Please give the manufacturer's name for any medicines, chemical or any specialised equipment mentioned (e.g. flumethrin (Bayvarol Strips, Bayer plc.)).

We look forward to hearing from you!

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Editorial

CONSERVATION

Aldo Leopold, widely acknowledged to be the father of wildlife conservation in America, considered the outstanding scientific discovery of the 20th century not to be television or radio, but rather the complexity of the "land organism". He wrote that, "the last word in ignorance is the man who says of an animal or plant, "What good is it?" If the land mechanism as a whole is good, then every part is good, whether we understand it or not. If the biota, in the course of aeons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering."
(Leopold, A. (1993) *Round River*. Oxford University Press, New York.)

Invertebrate conservation is frequently hampered by the "what good is it?" attitude towards invertebrate species, not only of laymen, but amongst conservationists as well. In this issue Ian Hughes and Heather Hall describe their work with *in situ* and *ex situ* conservation of the tadpole shrimp *Triops cancriformis*. This remarkable animal is now thought to exist in only one site in Britain. Hughes and Hall's article does more than tell an interesting story; it demonstrates both the gravity of the threat to relatively unknown, endangered invertebrate species and also the efficiency of invertebrate conservation programmes in contributing towards the protection of biodiversity.

Foremost among veterinary invertebrate conservationists, Mary Brancker this month celebrates 60 years of service in the veterinary profession. In her honour the Royal Society of Medicine is hosting a special meeting on 15 October. Mary, whose vigour and enthusiasm is an inspiration to many of her younger colleagues, is at last showing some signs of slowing down. She announced at the VIS AGM, the minutes of which appear later in this issue, that she wished to retire from the post of co-editor of the VIS Newsletter. Although she intends to continue contributing to the Newsletter by providing a link with the Terrestrial Invertebrate Taxon Advisory Group (TITAG), she will be sorely missed as its co-editor.

Veterinary Invertebrate Society

President:
Graham Rendall

Editor:
Martin Cooke

OCKHAM'S RAZOR

"Non sunt multiplicanda entia praeter necessitatem". (Entities are not to be multiplied beyond necessity). William of Ockham, the 14th century Franciscan scholar, held that what can be done with fewer things is done in vain with more; this principle, known as Ockham's Razor, has once again been applied to the VIS Newsletter. Although it is VIS's intention that the Newsletter should be published at least three times each year, the frequency achieved is determined entirely by the volume of items submitted. In order to produce the Newsletter we need a steady flow of articles, letters, reviews and news items; it would be refreshing if a greater proportion of these was supplied by VIS members, as is the case with the paper by Fred Frye in this issue on the role of springtails in human dermatitis. Other members: please put pen to paper (or preferably digits to keyboard!); a few more pieces would be welcome, never mind William of Ockham. In the same vein, the VIS could do with new members. Please help by copying the membership form on the back cover to colleagues.

Invertebrate News

A TRIBUTE TO MARY BRANCKER

Together with Bryan Davies and Andrew Cunningham, Mary Brancker was instrumental in inaugurating the Veterinary Invertebrate Society in 1991.

Bryan Davies reviews her long career....

Mary Brancker is this year celebrating 60 years of work in the veterinary profession. Let me make something quite clear; when I say 60 years of work, I mean just that. I do not mean 60 years in the profession, encompassing (say) a mere 40 years of work and the remainder spent in retirement. No, I mean 60 years work, for Mary has never retired. She is still as enthusiastic supporter of the profession as she was on the day she qualified.

I suppose that one could say that Mary was a general practitioner. She was in practice in Sutton Coldfield for many years, helping the profession to develop its now substantial involvement in the small animal field. She was not however inclined to take a narrow view of her remit. She also became deeply involved in the so-called exotic animal field. When I wanted advice on non-human primates or an expert witness on poisonous snakes I knew that I only had to telephone Mary. She was also a key person in the development of the veterinary profession's interest in fish and in the establishment of the Institute of Aquaculture at Stirling. And we know her as one of the founding members of the Veterinary Invertebrate Society. Along the way she somehow found time to be involved in veterinary politics at the highest level, becoming President of the British Veterinary Association, and to earn both a well-deserved OBE and Fellowship of the Royal College of Veterinary Surgeons.

It is very appropriate that the veterinary profession should show its appreciation of Mary's efforts and influence by joining with her to celebrate her full and varied professional career.

One final word of advice: be careful what you say to her. If you should ever start a sentence, "I've been thinking that the profession should play a part in....." you will find yourself on a committee or forming a society to do just that. So beware, her enthusiasm is infectious, but you don't have her energy; as they say, dynamite comes in small packets!

NATIONAL VARROA WEEK

National *Varroa* Awareness Week was launched on 4th August at London Zoo. Medwin Bew, head of the Central Science Laboratory's National Bee Unit, described how varroasis was confirmed for the first in UK in 1992 and how, since then, a total of 3,920 apiaries (over 10%) in 51 counties across England and Wales have been found to be infested. He emphasised the importance of *Varroa* awareness and regular treatment in the control of the mite.

Adrian Waring, General Secretary of the British Beekeepers' Association (BBA), explained that, with less than half the country's beekeepers affiliated to BBA, the greatest obstacle is lack of awareness of the problem. Nevertheless, varroasis is amenable to control, according to Peter Watson, R & D Manager, Bayer Animal Health. Bayvarol strips, which contain the synthetic pyrethroid acaricide, flumethrin, the same compound used in Bayticol scab and tick dip for sheep, can kill varroa mites within 24 hours and continue to work in hives for six weeks. Bayvarol strips leave no residues which can be detected in honey.

VETERINARY WORK WITH INVERTEBRATES IN EAST AFRICA

The 6th Annual General Meeting of the Veterinary Invertebrate Society was held in the Education Department at London Zoo on the 5th of July. The guest speaker, Professor John Cooper, of the Jersey Wildlife Preservation Trust, gave a very interesting talk about his experience in East Africa, focusing on the use of invertebrates in the region.

Invertebrates in East Africa have economic value as a very important food source; some species are also kept for research purposes. Keeping invertebrates as pets or for educational uses is rare in East Africa, although butterflies are farmed for export.

Professor Cooper is a strong supporter of the sustainable utilization of invertebrates, particularly in this region of the world, where food security is paramount. Invertebrates are widely used as an important food source and some are even farmed for exportation. Some of the edible invertebrates cited included lake flies, which are steamed and eaten as a pudding, many different species of termites (which, according to Professor Cooper, are delicious!), grass hoppers and *Acatina* snails, the latter being exported as a gourmet item to many European countries. Silkworm farming and beekeeping tends to be done by women and thus is of socio-economic importance.

Finally, Professor Cooper spoke about the clinical side of his involvement with invertebrates in Tanzania both in the Sokoine Veterinary School and elsewhere; he encouraged everyone to get to know these fascinating creatures a little bit better.

Sandra Jesus

MORE GOOD NEWS FOR SURFERS

The Veterinary Invertebrate Society has a website, courtesy of the Wildlife Health Information Partnership, based in Madison, Wisconsin. You can visit it at:

- http://www.emtc.nbs.gov/http_data/whip/vis-org.html

You will find it at the moment a little uninspiring, however we plan to include extracts from the Newsletter.

Other interesting web sites for the inveterate veterinary invertebrophile include:

- Amateur Entomologists Society http://www.ex.ac.uk.bugclub/
- BIOSIS Arachnida (very long!) http://www.york.biosis.org/zrdocs/zoolinfo/grp_arac.htm
- Newfoundland Insectarium http://www.elwood.k12.nf.ca.insect/

These can be useful sources of information, but always check the authenticity of the facts given. Please let us know if you come across any more good web sites.

BOOKS

Good books on invertebrates are often hard to find.

Mary Brancker recommends the following as good starting points for invertebrate topics….

Two good sources of books are:

E.W.Classey Ltd,
P.O. Box 93,
Faringdon,
Oxon SN7 7DR, UK
70 page catalogue of antiquarian, second-hand books and books in print.

AES Publications,
The Hawthorns,
Frating Road,
Great Bromley
Colchester CO7 7JN, UK
The Amateur Entomological Society has 25 publications.

The following titles may prove useful as a first point of reference:

The Encyclopaedia of Insects; ed. O'Toole, C.; George Allen & Unwin, London
Zoo & Wild Animal Medicine; ed. Fowler, M. E.; W. B. Saunders Company
Arachnida; proceedings of a one day symposium on spiders and their allies.
BSAVA Manual of Exotic Pets; BSAVA, Cheltenham

Various publications from UFAW, South Mimms, Potters Bar, Herts.
The Veterinary Formulary; British Veterinary Association, London
International Zoo Yearbook **30**; Zoological Society of London

Most of these books have useful references or bibliographies. Many of them are available at veterinary school libraries or at the library of the RCVS.

If you come across a good invertebrate book, which you think may be unknown to VIS members, please send us a short review.

NEW JELLYFISH

Summarised from: Martin, J. W., Gershwin, L. A., Burnett, J. W., Cargo, D. G., & Bloom, D. A. (1997) *Chrysaora achlyos*, a remarkable new species of scyphozoan from the eastern Pacific. *Biological Bulletin* **193**: 8-13

An enormous new species of scyphozoan jellyfish, *Chrysaora achlyos*, has been described from the eastern Pacific. *Chrysaora achlyos* has a fleshy, dark purple to black bell of up to 1 m diameter and lighter purple oral arms, reaching 6 m long. Large numbers were seen off the coasts of Mexico and southern California in 1989 and published photographs exist from as early as 1926. However, until now, insufficient collections had been made on the rare occasions when this remarkable animal has appeared to enable specific phylogenetic description on the basis of morphology and nematocyst ultrastructure. Little is known of its behaviour, distribution or life cycle and this description is based on four preserved specimens collected during the 1989 manifestation.

GIANT MILLIPEDE BURNS

In a retrospective review of 8 cases of millipede "burns" caused by *Polyconoceras* sp. in Papua New Guinea, most cases were seen in children and all in the rainy season. Clinical manifestations included a "burn", marked periorbital oedema and conjunctivitis. In no case was blindness a sequela, despite anecdotal reports to the contrary.

Hudson, B. J., & Parsons, G. A., (1997) Giant Millipede "burns" and the eye. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 91: 183-185

INVERTEBRATE CONFERENCES

A conference on the captive conservation of endangered invertebrates will be organised by the Terrestrial Invertebrate Taxon Advisory Group (TITAG) at the Zoological Society of London in the Spring of 1998. There will be papers by professionals, general discussions and posters. The meeting will be aimed at hobbyists and experienced breeders.

Several other meetings with invertebrate content at the Zoological Society of London will be of interest to VIS members:

- Four billion years of success, 11 November 1997
- Behaviour and conservation, 4-5 December 1997
- Collaborating for conservation, 9 December 1997
- Impacts of invasion by alien species, 10 March 1998
- Action for England's endangered animals, 5 May 1998
- Ideal homes: animals as architects, 9 June 1997

For full details contact the Zoological Society of London.

The World Association of Wildlife Veterinarians has announced two forthcoming conferences:

- Joint meeting with AAZV and CAZWV in Omaha, Nebraska, 16-22 October 1998
- Joint meeting with EWDA and EAZWV in Lyon, France, 20-25 1999

Letters

ARACHNID ECTOPARASITES

I am an Area Supervisor at the El Paso Zoo in Texas, USA. I supervise the area with all the arthropods and inverts.

We have two male desert hairy scorpions *Hadrurus arizonensis* that have a problem with black spots on their joints. One of them presented this problem on one of his back legs and the leg fell off at the black spot. We assumed it to be a type of fungus or mould, so our vet suggested using a 10% betadine solution. We had been treating them both once daily and they seemed to be more active, but still had no appetite and they have lost weight. Today I was showing one of my zoo keepers how to treat and restrain them for medication, when I noticed a tiny red bug on the white paper towel that the scorpion rested on. We were lucky enough to have some military zoologists at the zoo [today] and one of them collected several of the mite-like bugs and is going to try to get them identified for me in the lab at the military base.

Has anyone else experienced ectoparasites causing black lesions on scorpions and is there a treatment that won't harm the scorpion?

Rachel Watkins Rogers,
Area Supervisor
El Paso Zoo

rashel2@juno.com

This enquiry was received as the Newsletter was going to press and so there has been insufficient time to obtain a suitable reply. It is difficult to treat mites on arachnids as the compounds which kill mites are also likely to kill larger arachnids. One approach may be to remove the visible mites with a fine brush or a cotton bud dipped in petroleum jelly and the put the scorpions into a sterile environment. This should be repeated every other day. Of course it may well be that the mites are commensal and not the cause of the black lesions at all.

GOLDEN APPLE SNAILS

In response to Sharon Dungavell's letter in Issue 12 of the VIS Newsletter, Fredric Frye writes....

Since the softening of the snail shells seems to be involving only the older matrix, rather than the more recently laid-down shell, it probably does not stem from poor nutrition (calcium deficiency and/or phosphorus excess). There is a bacterial pathogen, *Beneckia chitinovora*, that could be responsible; however, I doubt that too; most often, it attacks freshwater crayfish.

Dr. Fredric L. Frye,
741 Plum Lane, Davis,
California 95616-3237 USA

Useful information about apple snails can also be found in:

Perera, G., & Walls, J. G. (1996) *Apple snails in the vivarium*. TFH Publications Inc., Neptune, New Jersey.
ISBN 0-7938-2085-5

Reviews

KEEPING BIRD-EATING SPIDERS

A Novice's Guide To Keeping Tarantulas
1 hour
GKVIDEO Productions

A Novice's Guide To Keeping Tarantulas is a new video presented by entomologist Keith Stiff. As its title clearly states, it is directed towards those embarking for the first time in the fascinating world of keeping these creatures.

Although the production is rather amateurish, the video is easy to follow and keeps your attention for the hour that it lasts. It covers all the commonly asked questions and goes into depth in some areas. The video begins with a very good introduction, giving general information on spiders and bird-eaters in particular; it clarifies some misconceptions about how dangerous they are and gives insights on classification illustrated by images of different species. The classification is a bit patchy and when the narrator mentions giant South American bird eaters the visual image displayed is of an African species, *Pterinochirus marinus*.. The main section shows how to set up the terrarium properly and how to accommodate the two principal types of bird-eating spiders (terrestrial and arboreal). Temperature and humidity are the two main environmental factors to be controlled in the terrarium. These are almost too easily set and adjusted by the presenter; a beginner could have some problems here and might end up wanting more tips and information than are provided in this video.

The part on feeding is good and there is useful advice on how to buy a new specimen and how to recognise healthy from sick looking spiders. At one point Stiff advises that arboreal species should be watered by spraying the vivarium as these species will not visit a water bowl on the ground. While it is certainly true that they will drink from the sprayed droplets, they will normally also visit a bowl on the floor of the vivarium. When on holiday you can leave a bowl for several days, but spraying without a trusted spider-sitter is impossible. The video does not mention that it is inadvisable to spray the spider directly as this can be stressful.

Keith Stiff correctly states in the section on handling that great care must be taken with some species and that not all can be handled. However he does not follow these observations with sufficient detail on safe handling techniques.

In the final section the process of moulting, often confusing for the novice, is impressively documented with great pictures.

In general this is a good source of visual information for those that are starting with bird-eating spiders, but further help from specialised books will be needed for those wanting to get really involved. The video is stronger in some areas than in others and, for example, does not cover the subject of breeding, the ultimate aim of most spider fanciers; however this is probably beyond the scope of a video aimed principally at beginners. As a complement to a good book on the subject, it is very useful, long overdue and highly to be recommended.

Javier Lopez and Craig Walker

REJECTING ECTOPARASITES

The Immunology of Host-Ectoparastic Arthropod Relationships
Ed.: Wikel, S. K. (1996)
331 pages
CAB International, Wallingford, UK
ISBN 0-85199-125-4

This book explores what the editor calls "immunoentomology": host immune responses to ectoparasitic arthropods. A greater understanding of such relationships is needed if we are to combat the challenges presented by vector-borne pathogens and effectively to control diseases caused to humans, domestic animals and wildlife by a multitude of arthropod parasites.

There are 13 chapters to the volume, covering subjects ranging from "The immunology of the skin" and "Mouthparts and feeding mechanisms of haematophagous arthropods" to "Immunology of scabies" and "Immune responses to fleas, bugs and sucking lice". Of the 14 contributors, one is from Britain and another from Australia: the others are all American. Most of the chapters consist of text, but there are also a few black-and-white photographs and some line drawings.

Although the publishers state that this book is "aimed particularly at medical and veterinary entomologists and acarologists", it will also be of value to clinicians and pathologists, especially those with an interest in dermatology.

John Cooper

MARINE INVERTEBRATES

The Reef Aquarium, Volume 1
Delbeek, C., & Sprung, J.
560 pages, $84.95
Ricordea Publishing Inc., and Two Little Fishies, Inc., Coconut Grove, Florida
ISBN 1-883693-12-8
A comprehensive guide to the identification and care of tropical marine invertebrates.

The Modern Coral Reef Aquarium, Volume 1
Fosså, S. A., & Nilsen, A. J.
Approx. 400 pages. $84.95
Birgit Schmettkamp Verlag
(USA distributor: Two Little Fishies, Inc., Coconut Grove, Florida)
ISBN 3-928819-29-1

Coral reef ecology and its practical application in closed system aquariums.

Giant Clams
Knop, D.
300 pages. $49.95
Dahne Verlag
(USA distributor: Two Little Fishies Inc., Coconut Grove, Florida)
ISBN 3-928819-29-1

A guide to the care of South Pacific tridacnid clams, including anatomy, reproduction and diseases.

Reef Notes 1, revisited and revised
Reef Notes 2, revisited and revised
Reef Notes 3, revisited and revised
Sprung, J.
192 pages. $19.95
Ricordea Publishing Inc., and Two Little Fishies, Inc., Coconut Grove, Florida
ISBN 1-883693-22-5
ISBN 1-883693-23-3
ISBN 1-883693-24-1

Updated extracts from Julian Sprung's question and answer column in the magazine *Freshwater and Marine Aquarium* between 1988 and 1994.

Further details of these marine invertebrate titles and other books, videos and CD ROMs, distributed by Two Little Fishies may be found on their web site:
http://www.twolilfishies.com/

HAWKEYE'S GUIDE TO BUGS?

A Colour Atlas of Medical Entomology
Burgess, N. R. H., & Cowan, G. O. (1993)
144 pages
Chapman & Hall Medical, London
ISBN 0-412-32340-0

This book is one of the Chapman and Hall Medical Atlas series, which covers a range of topics in human clinical medicine and surgery. It measures 27.5 x 22.0 cm and fits easily into a briefcase. In the laboratory or field its shape means that it can easily be opened and laid flat on a suitable surface. The Atlas has a glossy hard cover and would withstand a certain amount of rain or other environmental insults.

The Colour Atlas of Medical Entomology is written by two experienced scientists, one a Defence Advisor and Senior Lecturer in Entomology the other Professor of Military Medicine, both from the Royal Army Medical College in London. Photographs for the book have been provided by a range of individuals and institutions as well as comprising many of the authors' teaching slides.

There are 17 chapters. The introduction describes the phylum Arthropoda (the Atlas covers many types of invertebrate, not just insects) and discusses their significance in terms of disease to humans. Subsequent chapters detail different groups of arthropod, such as sandflies, midges, horseflies, fleas and arachnids. The penultimate chapter deals with "Bites, stings and other forms of attack" and the final chapter with "Control of medically significant arthropods". There is a comprehensive index, but, surprisingly, no references or suggested further reading
.

Like all colour atlases this volume has its shortcomings. The photographs and illustrations are generally excellent, but the text is often very basic. There are blank spaces at the end of chapters that could easily have been filled with more information, or even references! However the Atlas undoubtedly achieves its first aim, that of enabling users "to identify arthropods of medical and public health importance", and it goes some way towards assisting "assisting in the accurate diagnosis of the patient's condition and the prevention of recurrence". Medical entomologists will find it a helpful, practically orientated book and veterinary entomologists will benefit from having it on their shelves, especially when working with species of parasite that show little discrimination between *Homo sapiens* and other animals!

John Cooper

Annual General Meeting

MINUTES OF THE 6TH ANNUAL GENERAL MEETING OF THE VETERINARY INVERTEBRATE SOCIETY

The 6th Annual General Meeting of the Veterinary Invertebrate Society was held at London Zoo on 5th July 1997 at 2.00 p.m..

Members present

Graham Rendall (President), Mary Brancker, Bryan Davies, John Cooper, Julie Roxburgh

Apologies for absence

Tony Sainsbury, Andrew Cunningham, John Chitty

Minutes of the 5th AGM

The minutes of the 5th AGM, held at London Zoo on 25th May 1996, which were published in the VIS Newsletter (Issue 10), were read and accepted unanimously.

Matters arising

The President commented that the absence of a functional secretary during the past year had resulted in insufficient promotion of the VIS. John Cooper informed the meeting that there were many interest groups involved with invertebrates and suggested that the secretary should write to the Royal Entomological Society and the Amateur Entomological Society asking them to include a note in their journals about the VIS. Professor Cooper added that he considered it worthwhile to join the Amateur Entomological Society. The President requested that copies of the VIS Newsletter should be sent to the Amateur Entomological Society.

Treasurer's report

Graham Rendall presented the accounts for the year 1996. He commented that the principal source of income was membership subscriptions and that the principal expenditure was the cost of producing the VIS Newsletter. The accounts were accepted unanimously. Mr Rendall also announced that 14 memberships had been renewed and that three new members had joined the VIS since last year.

Election of Officers

After some discussion, the following people were elected unanimously to serve as Officers of the VIS for 1997:

President:	Graham Rendall
Secretary:	Martin Cooke
Treasurer & Membership Secretary:	Graham Rendall
Newsletter Editor:	Martin Cooke

Other business

In addition to the above elections, John Cooper agreed to assist Martin Cooke in the performance of the duties of secretary and also to act as a roving ambassador and international recruitment officer for the VIS. Other actions were agreed as follows. John Cooper will contact the British Veterinary Zoological Society regarding representation of the VIS at their next meeting. Martin Cooke will investigate promotion of the VIS via the Internet and will include the membership form in the Newsletter. Mary Brancker will liaise with Andrew Cunningham on the production of fact sheets about invertebrate topics.

There being no other business, the meeting was closed at 3.15 p.m..

Papers and Articles

In search for the haphazardly elusive: a follow-up report on an investigation into the possible role of collembolans in human dermatitis

Fredric L. Frye, 741 Plum Lane Davis, California 95616-3237 USA

Introduction

This is a follow-up to my previous paper entitled "Collemboliasis: yet another emerging zoonosis? A preliminary report," which was published in the April, 1996b issue of *Veterinary Invertebrate Society Newsletter,* **9**:2-7**.** During 1996 and early 1997 twenty supposed cases of human parasitism claimed to be associated with insects and other invertebrates, including but not limited to collembolans, were submitted initially to the National Pediculosis Association (NPA) and then submitted to me for microscopic identification and evaluation. Investigation of these patients and the objects that were recovered from them resulted in examination of over 1,000 individual specimens. In each instance, one or more physicians had diagnosed these patients as suffering from "delusional parasitosis." All of the patients -- and the NPA -- thought that this diagnosis was incorrect, and perceived it as being highly pejorative.

The vast majority of the patients were female. The only "infested" mate was the spouse of a male patient. One patient reported that her child was similarly infested but no specimens were submitted from the child.

Using the Internet to disseminate various "theories," many of these patients proposed alternative aetiologies that could be responsible for their suffering to the NPA and me. Citing Rachel Carson's *Silent Spring,* some of the "agents" suggested for their condition were: over-application of environmental pesticides and scabicides; over-application of topical antipediculosis medications; the ubiquitous *Serratia marcescens*, nematomorpha ("horsehair worms"); and "soil-dwelling" rotifers. The fact that most of these and many other proposed "causes" had been studied and then discarded due to the lack of credible evidence did not dissuade those with firmly held beliefs.

I was approached by the NPA to serve *pro bono* as their consulting pathologist and parasitologist. I did not fully appreciate how time-consuming this service would prove to be, and I naively accepted that invitation as a new and interesting challenge for which I was well prepared; after all, veterinary students receive far more training in parasitology than do human medical students.

This situation was rapidly getting out of control as I tried to inform and convince these patients that their *perceived* skin disorders could not be induced by non-parasitic organisms. Dealing with these patients requires patience, compassion, and sensitivity: Telephone calls in the middle of the night and on weekends were commonplace. As a variety of parasitic, non-parasitic, commensal, and/or otherwise innocuous organisms were being submitted to me from otherwise rational persons, it soon became evident that self-collection of specimens constituted an unreliable method for obtaining meaningful material for analysis.

Materials and methods

Initially, patients suffering from what they perceived to be integumentary signs and symptoms of pruritus, skin "tingling" or "pin-pricks" associated with arthropods, were encouraged by the NPA to submit specimens in small volumes of 40% ethyl alcohol (80-proof vodka).. These specimens included skin scrapings and dermal detritus that were obtained by the patients and, in only a very few instances, by their attending physicians. In addition, oral and nasal sputum and mucus, vaginal, and perianal specimens were self-collected and submitted directly to me. One patient was unalterably convinced that he had

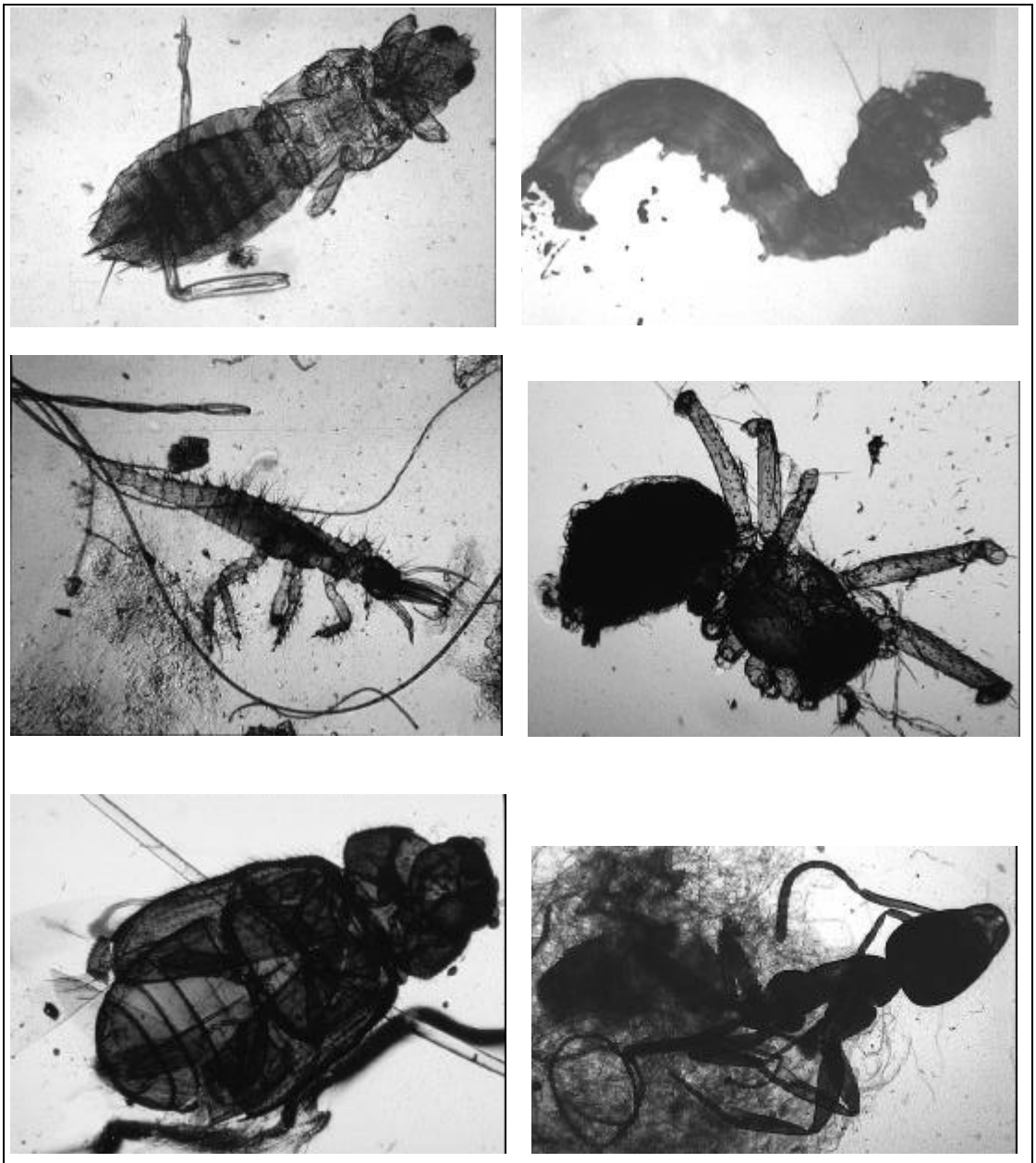

Figure 1. Some of the arthropods obtained from patients

passed a small octopus from his anus; however, he was unable to collect and send it to me. Several reported seeing "worms" in their excrement but, again, none was able to produce them for identification.

Upon receipt, each specimen was aspirated from the vodka, mounted in Hoyer's medium, coverslipped, and warmed for varying lengths of time on a heated plate until the specimens were sufficiently cleared and any air bubbles were excluded. The mounted and cleared specimens were examined microscopically immediately with plain and cross-polarised illumination, and then at 12-, 24-, and 96- hour intervals. Significant objects were recorded photographically on colour film with an Olympus BHB photomicroscope. A formal written report was issued, with copies furnished to the NPA, the patients, and their referring or attending physicians.

An ancillary investigation into the nature of felted wads of fibres was accomplished by selecting, mounting, clearing, photographing and comparing coloured and uncoloured (white) and natural cotton and wool cloth fibres from several garments. An identical protocol investigated artificial (Polarfil) fibres.

Results

The variety of "organisms" that were identified microscopically included: two intact collemobolans ("springtails"), one partial set of collembolan abdominal tergites with an intact spring-like furcula still attached, one lepidopteran larva ("caterpillar"), several ants, a tiny ichneumon wasp, numerous assorted coleopteran beetles (including flour beetles) and beetle body parts, several winged dipeteran flies and midges, empty flea egg cases, one neuropteran "ant-lion" (which the patient swears she extracted from a sore on her face), one psocid "book louse", numerous urticarial setae from dermestid carpet beetles, two spiders and several mites. (fig. 1).

Several stained recut sections of full-thickness skin biopsies were obtained from consulting dermatologists. Although each of these dermatologists and the pathologists who had examined these biopsies originally did not identify parasitic organisms, I found mites embedded deeply within the epidermis of four of them: the balance were negative. These mites were diagnosed as *Demodex follicularis* var *hominis*.

Skin scrapings from one elderly female patient yielded several mites that were identified as *Sarcoptes scabei* var *hominis*. This patient is also the person who submitted the greatest variety of insects and arachnids that she claimed were taken from her head and body. With the thought that perhaps these mites were really bird's nest parasites or wildlife mites that could have caused an infestation, I travelled to her locale and spent an entire day examining her home and garden. I even examined an active nest that was occupied by a very angry bluejay and her nestlings, but after vacuuming the mother bird, her nestlings, and their shared nest, I was not able to identify any mites or other ectoparasites from this or any other site.

It is interesting and instructive to note that in only one case was the mate or partner of an "infested" patient similarly affected. In that one notable case, I flew from California to an eastern state to examine the patients and their home to try to determine whether there was an organic aetiology for their (perceived) dermatological condition. Their home, automobiles and clothing were examined carefully; samples from these sites were gathered for subsequent processing and microscopic investigation. Skin scrapings and full-thickness skin biopsies were obtained with the co-operation of a sympathetic dermatologist. Nothing was found in the wife's skin scrapings. However, two intraepidermal mites that are consistent with *Demodex follicularis* var. *hominis* were identified in stained serial skin microsections of her husband's full-thickness skin biopsies. Whether these mites, which are commonly found in the nasolabial folds in the majority of human adults, were the aetiologic agent in this patient is conjectural; however, it might be significant that these mites also were found in skin sections that were obtained from this patient's arm and shoulder. Certainly, the mere finding of these mites served to validate the belief of this affected patient and his loved ones.

An uncounted, but large number of "fibre-bugs" were a consistent finding in the specimens submitted by every patient. Upon microscopic examination and comparison with known exemplars, they were identified positively as lint balls composed of matted cotton, wool, and artificial fibres.

Discussion

The early finding of clearly established parasitic mites in at least some of the patients that were referred to me by the NPA served to spur the investigation and to validate the beliefs of many who were closely following the progress of my efforts by "networking" with each other via telephone, facsimile, post and e-mail. Thus, shortly after one patient had learned the identity of her "bugs," those results were disseminated widely among others in the "network."

In analyzing over a year's effort to elucidate the cause of this puzzling spate of human suffering, it is now sufficiently clear to me that the

collembolans that were initially blamed as the prime supects were unfairly maligned. Certainly, they (like so many other arthopods) possess hair-like setae which, when they come into contact with sensitive mammalian skin, can cause irritation and even florid urticaria. However, much valuable time and materials were expended in searching for something that may not exist, except in the imaginations of those who perceived that they were infested. It has been an interesting experience that has been highly instructive.

In mid-1996, I was invited by the NPA and Harvard University's School of Tropical Medicine and Public Health to present a paper describing my findings. I entitled the lecture "Evaluation of patients presenting with suspected pediculosis, scabies or delusional parasitosis." In that lecture, I exhibited photo-micrographs of some of the organisms and inanimate objects that I had identified from the patients who were referred to me by the NPA.

The final slide that I displayed was the quote by Dr. Daniel E. Koshland, former editor of the prestigious ***Science*** magazine, which I believe represents my reaction to this interesting foray into comparative medicine, "The gene for unbridled dedication to a lost cause will always overwhelm the pure logic gene**."**

In a wide-ranging colloquial discussion following my presentation, I found that my colleagues at Harvard who also have examined microscopically numerous "fibre bugs" and other self-collected specimens from patients believing themselves to be infested, had come to the same inescapable conclusion as I had that the vast majority of these unfortunate persons were tormented by a disorder that should most appropriately be treated by a sympathetic psychiatrist. Sadly, most of the patients will not accept that verdict and, thus, will continue to suffer.

Conservation of the tadpole shrimp *Triops cancriformis*

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Introduction

The tadpole shrimp, *Triops cancriformis*, is a brachiopod crustacean related to shrimps, lobsters and crabs. It is an extraordinary animal, reaching 100 mm in length and bearing superficial resemblance to the horseshoe crabs and prehistoric trilobites. This species is found throughout Western Europe, ranging from Spain in the south to Sweden in the north, west to Britain and east to Russia. In Britain, the tadpole shrimp has been reported to occur in only two sites in this century. The northern site, in Kirkcudbrightshire, Scotland (Balfour-Browne, 1948), is thought to have been lost to the sea (Galliford, 1967). The only site where the species is currently known to exist in Britain is in the south of England, but due to the vulnerability of the site the exact location is not given in this paper.

Life history

Tadpole shrimps live in temporary pools: The existing site for the species in Britain is pool of approximately 30 m diameter, reaching a maximum depth of 30 cm, but drying out completely from May to September. This pool is close to a busy road and is heavily trodden by cattle, horses and sheep, putting it at risk from pollution, as well as agricultural drugs such as the lung-worm treatment, ivermectin. This type of habitat is very vulnerable to changes in grazing intensity land management.

The tadpole shrimp survives the extreme environmental conditions of the temporary pool through an unusual reproductive cycle (Hughes, 1997). During the wet period, eggs hatch to produce metanauplii which, after two to three instars resemble miniature adults. With each moult, more body segments, appendages and pigment appear. Sexual maturity is reached

after about 12 days. *T. cancriformis* from the southern part of the range carry out sexual reproduction, but in the rest of the range, reproduction is primarily asexual which means that a pool can be colonised from a single egg. Mature tadpole shrimps produce over 400 eggs which are initially held in brood pouches for 24 hours before being deposited into shallow excavations in the substrate. The eggs are adhesive and become rapidly coated by the substrate that acts as a camouflage and to retain moisture: The eggs require six days in water before reaching gastrulation, after which they are able to survive prolonged desiccation, possibly for periods up to 15 years (Tasch, 1963).

Conservation

Although the tadpole shrimp is at the northern limit of its range in Britain, it is currently unclear whether this represents a unique isolated population. Current taxonomy has identified three sub-species of *Triops cancriformis* (Longhurst, 1955), although there is evidence to suggest that this may be an oversimplification (Fryer, 1988).

In Britain, *Triops cancriformis* is listed under Schedule 5 of the Wildlife and Countryside Act (1981). The existing site for the species is a Site of Specific Scientific Interest (SSSI), as well as being protected by other legislation. In 1993, English Nature approached the Federation of Zoos to develop a captive breeding programme for the species. A *Triops* Conservation Group (within the Fish and Aquatic Taxon Advisory Group) was established, involving English Nature, the Wildlife Trusts, The Forestry Commission, Chester, Dudley and London Zoos, The Fish Conservation Centre in Stirling, The Universities of Buckingham and Nottingham, Pond Action, and Patrick Wisniewski of the Wildfowl and Wetlands Trust (WWT).

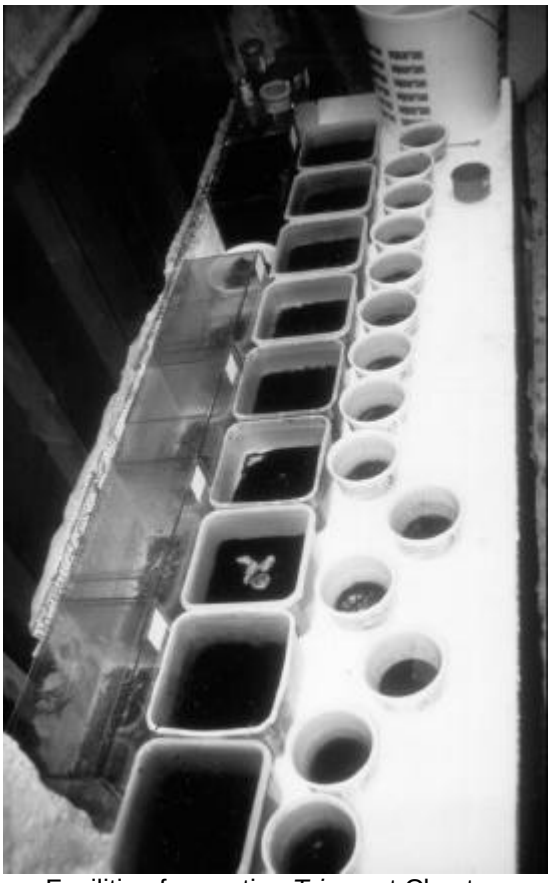
Objectives

The group identified the following key objectives for the conservation of the tadpole shrimp in Britain:

- To develop the husbandry methods to maintain and breed *T. cancriformis* in captivity, as an 'insurance' against their extinction from Britain.
- To develop an Action Plan for the long-term conservation of tadpole shrimps in the UK.

In situ conservation

Survey work is currently underway by Pond Action to establish the presence of tadpole shrimps in other temporary ponds in Britain, primarily by sampling sites near the known historic site in Scotland and the existing site in the south of England.



Facilities for captive *Triops* at Chester zoo
photo: Justin Bell

Captive breeding

Captive populations were established using samples of mud (collected under licence) from various areas of the pool (sampled by Ian Hughes, Dudley Zoo and David Hughes, Glasgow Zoo). Samples were then distributed to members of the group. Only two of the five mud samples yielded *Triops cancriformis*, (Dudley Zoo and WWT) and animals from these hatchings were distributed to a number of members of the group. Full details of the husbandry methods are described by Hughes (1997).

Successful hatching methods were achieved by gradually wetting mud from the dry state in full sunlight, usually in glass or plastic aquaria. After hatching, the tadpole shrimps were left in primarily natural settings with no filtration, but water and mud changes were carried out. *Triops cancriformis* feeds on a wide range of organic material. From the second instar, tadpole shrimps feed on a variety of micro-organisms, but powdered tropical fish and goldfish flakes provided all necessary nutrients. Adults were also fed *Daphnia* spp. and dried *Tubifex* spp., and a range of diets that includes bacon, chicken, liver, beef and frozen bloodworm have all been fed successfully.

Tadpole shrimps have now been successfully raised and bred (to third generation at Chester Zoo) at a number of institutions. Husbandry methods are now being developed as a protocol for use by additional organisations joining the programme. The captive population will be used as a reserve population in case of any catastrophic event to the single site containing the wild population. Releases to additional sites will only be considered once the survey work has been completed and only by carefully following IUCN (World Conservation Union) guidelines for reintroduction programmes.

Species Action Plan

Dr Peter Maitland (The Fish Conservation Centre in Stirling) prepared the Species Action Plan for English Nature, in collaboration with the *Triops* Conservation Group. Although the plan is currently under review, the primary goals are as follows:

- To determine the cause of the decline of tadpole shrimps in the UK.
- To understand the environmental requirements and biology of tadpole shrimps.
- To maintain captive populations in British zoos.
- To research the effects of ivermectin on captive bred populations of tadpole shrimps.
- To carry out genetic analysis to determine the difference (if any) between European, Asian and British tadpole shrimps.

Genetic studies

The investigation of the genetic differences between different *Triops* species, sub-species and populations has been undertaken by the University of Nottingham. At present, results have been limited by problems rearing tadpole shrimps in sufficient numbers to carry out genetic analysis.

Conclusions

The work of the *Triops* Conservation Group has demonstrated the value of captive breeding as a complementary role for conservation programmes. The work to date has demonstrated that there is still an enormous amount to be learnt about tadpole shrimps in Britain, and has served to highlight the importance of neglected habitats such as temporary pools. The role of zoos in this programme has initiated a comprehensive education programme, including special display panels at a number of zoos and a travelling exhibit at aquarist shows. This has increased the awareness of the threats to such an extraordinary native invertebrate species.

Acknowledgements

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Tailpiece

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